CHEMICALS

BestPractices
Project Case Study

January 2002

OFFICE OF INDUSTRIAL TECHNOLOGIES
ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Control Scheme Modifications Increase Efficiency of Steam Generation System at ExxonMobil Gas Plant

Benefits

- Saves over $375,000 annually
- Reduces annual energy consumption by 170 billion Btu
- Reduces air emissions

Applications

Improving control strategies can increase the performance of almost any steam system. Steam systems are found throughout industry and consume a significant portion of the energy used at manufacturing plants.

Summary

In 1998, control scheme modifications were made to the steam system at ExxonMobil's Mary Ann Gas Plant in Mobile, Alabama, following a system-level energy survey. Before the modifications, the plant was operated to baseload the boilers and maximize the output of the main turbine generator. After the modifications, the plant operated in a more efficient thermal following mode. The modifications that were performed reduced steam flow through the high-to-medium and medium-to-low pressure reducing stations and into the low-pressure steam condenser. These changes have reduced energy consumption by 170 billion Btu, and saved about $375,000 annually, with no capital investment. The original control scheme was based on past conditions, where excess high-pressure steam was provided by waste heat boilers. Changes in operating conditions now require production of high pressure steam from fired boilers.

Plant Overview

The plant's steam system operates with three main headers: a high-pressure 450-psig header, a medium-pressure 60-psig header, and a low-pressure 20-psig header. The fired boilers and the main waste heat recovery steam generators produce 450-psig steam. One large steam turbine generator and some small turbines operate between the high- and medium-pressure headers. These turbines and waste heat boilers produce the medium-pressure steam while the low-pressure steam is generated by waste heat boilers and from pressure reducing valves operating off the medium-pressure header.

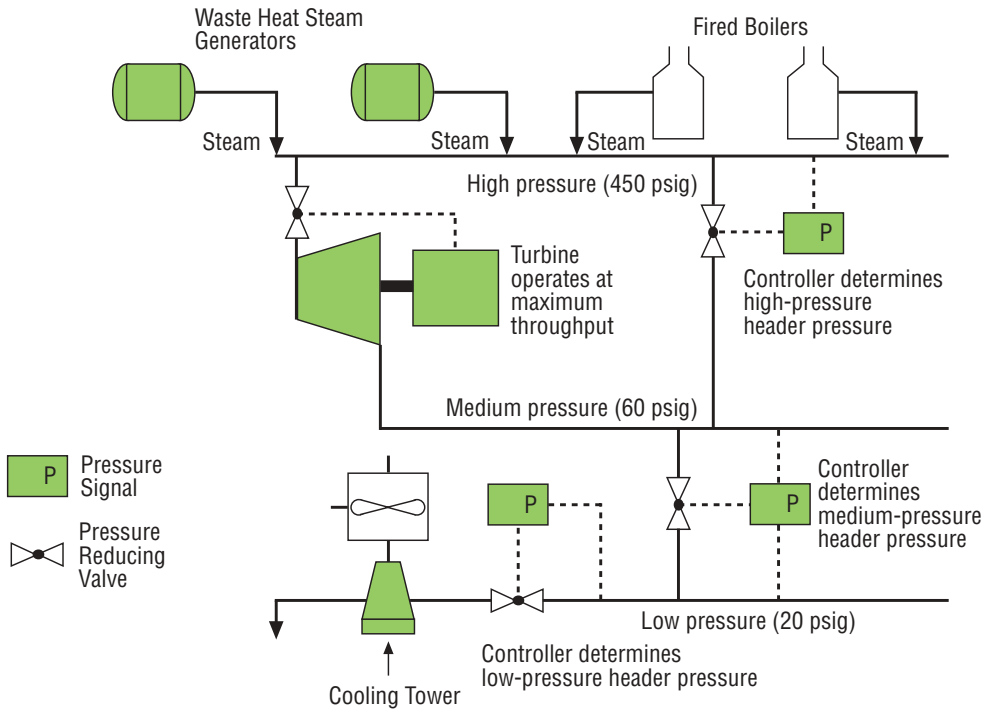
Project Overview

The energy survey helped determine that the steam system's efficiency could be improved. The system was operated in a way that base loaded the boilers to maximize the output of the main back pressure turbine generator. Large amounts of high-pressure steam were passed through pressure reducing valves to produce medium-pressure steam. Then, considerable volumes of medium-pressure steam were reduced to low-pressure steam to control pressure in the medium-pressure steam header. Finally, significant amounts of low-pressure steam were sent to condenser units. A large amount of unnecessary steam was produced, reduced in pressure, and condensed.

Plant engineers changed the system so that the pressure on the high-pressure steam header could be controlled by varying the output of the boilers. The steam supply to the turbine generator is now determined by the medium-pressure header steam requirements, so the turbine generator is essentially a thermal following unit. To avoid overloading, the steam turbine controller monitors generator output and limits the amount of steam. The pressure on the low-pressure header is still controlled by the pressure reducing station.

All of the changes made were revisions of the existing control system. The modifications to the boilers and turbine generators included reprogramming the steam controllers and shifting the primary control of high-pressure steam to the boilers.

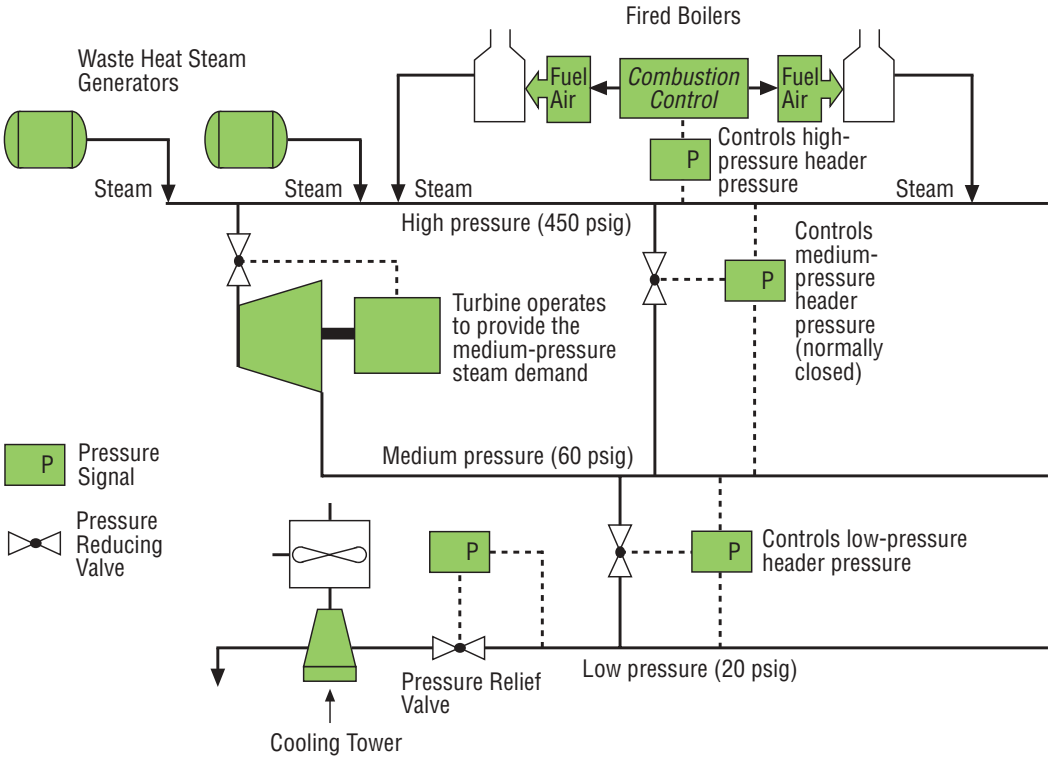
Diagram of Original Steam System



Results

The modifications to the control scheme substantially improved the operation of the gas plant's steam generation and distribution system. The aggregate savings from the modifications to the control scheme was $375,000 per year. The return on investment was excellent because no capital investment was required and only a limited amount of engineering time was required to make the modifications. With the current configuration, emissions from the boilers have also been reduced.

Diagram of Revised Steam System



Lessons Learned

This project shows that changing the way a system is controlled can sometimes bring substantial savings to a plant. This is especially true for older plants that have undergone process changes. In many cases, existing equipment can be used, and no capital investment is required.

Industry of the Future—Chemicals

The chemical industry is one of several energy- and waste-intensive industries that participate in OIT's Industries of the Future initiative. In December 1996, the chemical industry published a report entitled ***Technology Vision 2020: The U.S. Chemical Industry*** *that helps establish technical priorities for improving the industry's competitiveness and develops recommendations to strengthen cooperation among industry, government, and academia. It also provides direction for continuous improvement through step-change technology in new chemical science and engineering technology, supply chain management, information systems, and manufacturing and operations.*

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BestPractices is part of the Office of Industrial Technologies' (OIT's) Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together the best-available and emerging technologies and practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices emphasizes plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small- and medium-size manufacturers.

Project Partners

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DOE/GO-102002-1320
January 2002